RADAR SIGNAL PROCESSING

17ECMC2T6D **Credits: 4**

Lecture: 4 periods/week **Internal assessment: 40 marks**
Semester end examination: 60 marks

Prerequisites: Radar Systems, Digital Signal Processing

Course Objectives

- To illustrate the principles of Radar Systems and Signal Processing techniques.
- To analyze and detect the radar signals in presence of noise.
- To explore about the radar waveforms
- To acquire knowledge about pulse compression Radar.

Course Outcomes

Upon the completion of this course, the student will be able to

- Understand the principles of Radar Systems and Signal Processing techniques.
- Detect radar signals in noise using different receivers.
- Analyse the properties of Ambiguity function and waveform design requirements.
- Describe the concepts of pulse compression Radar.

UNIT –I

Introduction: Radar Block Diagram, Radar Equation, Information Available from Radar Echo. Review of Radar Range Performance– General Radar Range Equation, Radar Detection with Noise Jamming, Beacon and Repeater Equations, Bistatic Radar. Matched Filter Receiver – Impulse Response, Frequency Response Characteristic and its Derivation, Matched Filter and Correlation Function, Correlation Detection and Cross-Correlation Receiver, Efficiency of Non-Matched Filters, Matched Filter for Non-White Noise.

UNIT –II

Detection of Radar Signals in Noise: Detection Criteria – Neyman-Pearson Observer, Likelihood-Ratio Receiver, Inverse Probability Receiver, Sequential Observer, Detectors – Envelope Detector, Logarithmic Detector, I/Q Detector. Automatic Detection - CFAR Receiver, Cell Averaging CFAR Receiver, CFAR Loss, CFAR Uses in Radar. Radar Signal Management – Schematics, Component Parts, Resources and Constraints.

UNIT -III

Waveform Selection: Radar Ambiguity Function and Ambiguity Diagram – Principles and Properties; Specific Cases – Ideal Case, Single Pulse of Sine Wave, Periodic Pulse Train, Single Linear FM Pulse, Noise Like Waveforms, Waveform Design Requirements, Optimum Waveforms for Detection in Clutter, Family of Radar Waveforms.

UNIT –IV

Pulse Compression in Radar Signals: Introduction, Significance, Types, Linear FM Pulse Compression – Block Diagram, Characteristics, Reduction of Time Sidelobes, Stretch Techniques, Generation and Decoding of FM Waveforms – Block Schematic and Characteristics of Passive System, Digital Compression, SAW Pulse Compression.

Text Books:

1. Radar Handbook - M.I. Skolnik, 2nd Ed., 1991, McGraw Hill.

2. Radar Design Principles : Signal Processing and The Environment - Fred E. Nathanson, 2nd Ed., 1999, PHI.

Reference Books:

1. Radar Principles - Peyton Z. Peebles, Jr., 2004, John Wiley.

2. Radar Signal Processing and Adaptive Systems - R. Nitzberg, 1999, Artech House.

3. Radar Design Principles - F.E. Nathanson, 1st Ed., 1969, McGraw Hill.

4. Introduction to Radar Systems - M.I. Skolnik, 3rd Ed., 2001, TMH.